

Research Note 80-21

METHODOLOGIES FOR CORRECTING DEFICIENCIES  
IN TRAINING PROGRAMS

William D. Spears, Jeffery L. Maxey  
and Marvin D. Roush II

Seville Research Corporation

ARI FIELD UNIT AT FORT KNOX, KENTUCKY

AD A 125892

DTIC FILE COPY



U. S. Army

Research Institute for the Behavioral and Social Sciences

April 1980

Approved for public release; distribution unlimited.

83 03 21 124



# U. S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency under the Jurisdiction of the  
Deputy Chief of Staff for Personnel

JOSEPH ZEIDNER  
Technical Director

FRANKLIN A. HART  
Colonel, US Army  
Commander

---

Research accomplished under contract  
for the Department of the Army

Seville Research Corporation

## NOTICES

DISTRIBUTION: Primary distribution of this report has been made by ARI. Please address correspondence concerning distribution of reports to: U. S. Army Research Institute for the Behavioral and Social Sciences, ATTN: PERI-TP, 5001 Eisenhower Avenue, Alexandria, Virginia 22333.

FINAL DISPOSITION: This report may be destroyed when it is no longer needed. Please do not return it to the U. S. Army Research Institute for the Behavioral and Social Sciences.

NOTE: The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Research Note 80-21	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle)  METHODOLOGIES FOR CORRECTING DEFICIENCIES IN TRAINING PROGRAMS		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER PR 80-8
7. AUTHOR(s)  William D. Spears, Jeffery L. Maxey and Marvin D. Roush, II		8. CONTRACT OR GRANT NUMBER(s)  MDA903-79-C-0545
9. PERFORMING ORGANIZATION NAME AND ADDRESS Seville Research Corporation 400 Plaza Building Pensacola, Florida 32505		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Research Institute for the Behavioral and Social Sciences, 5001 Eisenhower Avenue, Alexandria, VA 22333		12. REPORT DATE April 1980
		13. NUMBER OF PAGES 66
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) ARI Field Unit, Fort Knox Steele Hall Fort Knox, KY 40121		15. SECURITY CLASS. (of this report)  Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report)  Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES  COTR was Donald M. Kristiansen, ARI Field Unit, Fort Knox, KY.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Training program evaluation (TPE)                      Management of attitudes Corrective measures                                      Problems in performance testing Redesign training programs Training support and facilitation Instructor characteristics and qualifications		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  This report has four major sections, of which the introduction and approach is the first. Section I discusses the scheme which was developed to guide training analysts in pinpointing shortcomings in instructional practices so that corrections would be specific to the problems. Section II presents and explains 15 principles regarding the use of practice, guidance and feedback. A training analyst should be thoroughly familiar with these 15 principles when he conducts a training program evaluation (TPE), determines sources of performance deficiencies and identifies revisions needed in instructional		

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

1

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

con X  
Item 20 (continued)

practices. Section III examines instructional deficiencies that might be indicated by items of evidence listed by the Harless Performance Guild, Inc. (contracted to develop a prototype TPE methodology). In this section, ways to pinpoint sources of training problems are explained together with corrective measures that focus on the sources. The final section discusses the five areas of administrative responsibility that are critical to effective training programs.

Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A	



Research Note 80-21

METHODOLOGIES FOR CORRECTING DEFICIENCIES  
IN TRAINING PROGRAMS

William D. Spears, Jeffery L. Maxey  
and Marvin D. Roush II

Seville Research Corporation

Submitted by:  
D. F. Haggard, Chief  
ARI FIELD UNIT AT FORT KNOX, KENTUCKY

Approved by:  
*E. A. Dusek*, Director  
PERSONNEL AND TRAINING  
RESEARCH LABORATORY

U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES  
5001 Eisenhower Avenue, Alexandria, Virginia 22333

Office, Deputy Chief of Staff for Personnel  
Department of the Army

April 1980

---

Personnel and Training

Approved for public release; distribution unlimited.

## SUMMARY

### THE PROBLEM

The Army Research Institute for the Behavioral and Social Sciences (ARI) has been tasked to develop a methodology for conducting training program evaluations (TPEs) and procedures for revising training programs to eliminate performance deficiencies discovered during TPEs. In a previous contract, a prototype methodology for TPEs was developed, but that effort did not include the development of procedures to correct flaws in training programs. The purpose of the project reported here was to develop the corrective procedures for shortcomings in training that might be discovered during TPEs.

### APPROACH

The various training shortcomings and indications thereof identified in the earlier study were the focus during this project. The framework for viewing the problems included two major foci. First, all aspects of training were viewed as an integrated system. The original purpose was thus expanded to include consideration of administrative issues related to training as well as procedures for correcting instructional deficiencies. The training analyst is thus provided perspective for viewing training problems whether or not he is in a position to take action regarding all of them. Second, the methodology for identifying performance deficiencies focused on systematic observations and analyses of instructional processes and their effects on trainees' daily achievements. A list of principles regarding the use of practice, guidance, and feedback during training was developed to guide both the identification of instructional deficiencies and their correction.

## RESULTS

Analyses of problems were grouped under two broad topics. Problems related to instructional processes were examined in terms of their sources that can be identified by observations during training. Corrective measures involving effective use of practice, guidance, and feedback were then explained as applicable to each source of difficulty. The second broad group of problems concerned areas of administrative responsibility. They were addressed under five heads: Indications of Need to Redesign Training Programs; Training Support and Facilitation; Instructor Characteristics and Qualifications; Management of Attitudes; and Problems in Performance Testing. The focus for the discussion of each of these five areas was the need for administrative resolve and action to prevent problems from arising when possible, and to take prompt corrective steps when they do occur.

## PREFACE

This report describes the results of a research project that was undertaken to develop procedures for eliminating training deficiencies discovered during training effectiveness evaluations. The research was sponsored by the Army Research Institute for the Behavioral and Social Sciences (ARI) under Contract No. MDA903-79-C-0545. Mr. Donald M. Kristiansen of the ARI Field Unit at Ft. Knox, Kentucky, was the Contracting Officer's Technical Representative. Dr. Paul W. Caro was the Seville Program Manager for the project, while Mr. Jeffery L. Maxey served as Project Director. Dr. William D. Spears, Mr. Marvin D. Roush, II, and Mr. Robert N. Isley comprised the project staff.



## TABLE OF CONTENTS

	<u>Page</u>
I. INTRODUCTION & APPROACH	1
The Present Project	2
Approach	4
Organization of the Report	7
II. PRINCIPLES OF PRACTICE, GUIDANCE, AND FEEDBACK	8
Practice	9
Guidance	13
Feedback	15
Summary	18
III. IDENTIFYING AND CORRECTING INSTRUCTIONAL DEFICIENCIES	19
Summary	48
IV. TRAINING DEFICIENCIES RELATED TO ADMINISTRATIVE PRACTICES	49
Indications of Need to Redesign Training Programs	49
Training Support and Facilitation	53
Instructor Characteristics and Qualifications	56
Management of Attitudes	57
Problems in Performance Testing	61
Summary	66

## I. INTRODUCTION AND APPROACH

Effective training is the primary requisite for military preparedness. Ensuring effective training with a minimum investment of time, effort, and resources is becoming more and more difficult due to the increasing complexity and diversity of weapon systems. The skills required to employ modern weapon systems are often highly technical and always exacting. As a result, the design of optimal training programs requires the same care and attention to detail that is necessary to design the equipment.

Current training technology provides valuable guidance for designing military training programs that are both effective and efficient.<sup>1</sup> One shortcoming, however, is that training technology is as much an art as a science. It is not likely that an optimum program can be designed on the first try. It will usually be necessary to implement the program and then evaluate its effectiveness. In doing so, deficiencies in the training program can be identified, and the program revised to eliminate them.

Training program evaluations (TPEs) and subsequent program revisions seem fairly straightforward, but in practice they are not. The Army regulations, manuals, and handbooks on TPE and training are explicit

---

<sup>1</sup>For an extensive review of literature related to the systematic design of training programs, see Montemerlo, M.D., and Tennyson, M.E. Instructional Systems Development: Conceptual Analysis and Comprehensive Bibliography (NAVTRAEQUIPCEN IH-257). Orlando, FL: Naval Training Equipment Center, February, 1976. For summaries of learning principles applicable to military training, see Wheaton, G.R., Rose, A.M., Fingerman, P.W., Korotkin, A.L., and Holding, D.H. Evaluation of the Effectiveness of Training Devices: Literature Review and Preliminary Model (Research Memorandum 76-6). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences, April 1976; and Appendix A of Wheaton, G.R., Fingerman, P.W., Rose, A.M., and Leonard, R.L., Jr. Evaluation of the Effectiveness of Training Devices: Elaboration and Application of the Predictive Model (Research Memorandum 76-16). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences, July 1976.

regarding what should be done, but they are not explicit on how to do it. This lack of direction is a serious shortcoming because Army training analysts often are not expert in training technology. They need specific guidance that explains how to go about their task, what to look for, and what to do about the training deficiencies they discover.

The Army Research Institute for the Behavioral and Social Sciences (ARI) has been tasked to fill this need. They are to develop a methodology for conducting TPEs, and guides for revising training to eliminate flaws programs. The methodology is to be applicable generally in training programs for a variety of weapon systems. As a vehicle for their development, however, ARI selected the training program for the XM1 tank system. The XM1 was well into the operational testing (OT) cycle, and the work to be done could be accommodated to the OT phasing.

#### THE PRESENT PROJECT

ARI contracted with Harless Performance Guild, Inc. (HPGI) to develop a prototype TPE methodology.<sup>1</sup> Though the focus was on the XM1 tank, the methodology is generally applicable to a number of Army weapon systems and training programs. The effort did not include the development of procedures for correcting training deficiencies discovered during TPEs. That task was the province of the project described in this report. The work was to be completed in three phases as identified in the ARI Statement of Work:

Phase I: Review information documenting the XM1 Transition Training Program (XM1 TTP), and conduct a training effectiveness evaluation of this program.

---

<sup>1</sup>Harless Performance Guild, Inc. Guidelines for Conducting a Training Program Evaluation (Working Paper FKFU 80-1). Fort Knox, KY: U.S. Army Research Institute for the Behavioral and Social Sciences, November 1979.

Phase II: Derive training implications from the Phase I effectiveness evaluation and develop guides documenting the process used to derive the implications.

Phase III: Identify revisions to the XM1 TTP from analyses of the Phase II implications and develop guides documenting the process used to identify the revisions.

Work on Phase I was documented in a separate report.<sup>1</sup> As explained in that report, it was not possible to conduct a TPE of the XM1 TTP because the operational testing had already been conducted and the documentation describing its conduct was incomplete. Specifically, it could not be determined what tasks had been practiced during training, the nature of practice activities, the performance standards met during training, or how the program was implemented. Therefore, Phases II and III of the project could not build specifically upon documented, empirically established relations of training practices and TPE outcomes. As a consequence, Phase II was revised and Phase III was eliminated.

During the revised Phase II, guidance was to be developed for correcting the instructional deficiencies that result in performance deficiencies on a final test following training. In keeping with the goal of general applicability of the methods involved, the training deficiencies were to be addressed not as problems in XM1 training per se, but as shortcomings that could arise in any training program where skill performance is the concern. The guidance would be such that it could be followed by persons who are not expert in training technology.

---

<sup>1</sup> Seville Research Corporation. Phase I - Training Effectiveness Evaluation of the XM1 Operational Test II Transition Training Program (Letter Report). Pensacola, FL: Seville Research Corporation, October 1979.

## APPROACH

To provide an integrated view of sources of performance deficiencies, it was necessary to consider training programs as a whole. In addition to problems arising from instructional practices per se, inadequacies of training content were addressed, as were common difficulties arising from lack of administrative support and absence of facilitative policies. The entire training and TPE efforts were viewed as a system, and a variety of factors that can result in less than adequate skill performance were examined as they impact the total training system. Furthermore, a scheme was developed to guide training analysts in pinpointing shortcomings in instructional practices so that corrections can be specific to the problems.

### Training As A System

A "system" is an integrated enterprise in pursuit of a goal. It is integrated in that no part of the system can be viewed meaningfully by itself. Each aspect depends on the proper functioning of all other aspects. As a system, a training program has the goal of preparing trainees for quality, efficient job performance. Whether it achieves this goal depends, first, on the nature of training objectives. They must reflect job performance requirements in such a way that trainees who achieve the objectives perform on the job as desired. Next, the design of the training should maximize the likelihood that trainees will achieve the objectives. In doing so, training practices and conditions must be adapted to the characteristics of trainees, their aptitudes, entry skill levels, learning styles, and attitudes.

In fulfilling these conditions, provisions must be made for adequate, timely administrative support. Personnel and other resources needed for training should be available. Policies and practices concerning the design and management of the training program should facilitate every aspect of the training process, ranging from the selection and preparation of instructors to a regular monitoring of training quality and timely corrective actions when problems are discovered.

An essential characteristic of a smoothly functioning system is an effective communication network. If each aspect depends on every other aspect, any shortcomings or changes in one will have consequences for the others. For example, if training and test contents differ, an analyst should attempt to identify the reason for the disparity so that something can be done either about the test or the training. He should find out whether the test content reflects job requirements that are within the scope of the training program. If so, training objectives should be examined for appropriateness and revised as needed. The contents of practice sessions must be revised accordingly, and training procedures adapted to them. The entry characteristics of students must be examined in terms of the new training objectives, and if necessary, special training must be provided to overcome entry skill deficiencies.

On the other hand, if the test, not the training content, is inappropriate, the communication network should provide for the analyst to notify someone in authority so the test can be revised. When viewed as a system, the test is an integral part of the training program whether or not the test and the program are under control of the same personnel.

Following this orientation, several training deficiencies are discussed more than once in the present report, for often a problem and its

correction can have implications in more than one area of responsibility. Even simple misuses of feedback during practice, for example, can indicate a need for administrative action to improve instructor selection or training. Although a training analyst may not be involved in correcting sources of some problems, he is expected to distinguish them from instructional deficiencies per se. The view of training as a system provides a perspective for making the distinction through an understanding of all training deficiencies.

#### Identification of Instructional Deficiencies

Practical and coherent measures for correcting instructional shortcomings require a method for pinpointing what goes wrong during instruction. More than likely, corrections would involve insightful applications of instructional technology to training methods. That is, uses of practice, guidance, and feedback would have to be adapted to exploit the profound contributions these factors make to training. The types of observations required to diagnose instructional deficiencies involving these factors may not always be possible. However, solutions of instructional problems must be specific to the sources of difficulty if they are to be effective. Therefore, personnel responsible for correcting instructional shortcomings should attempt to make the necessary observations.

Specifically, such personnel should observe trainees during training practice so they will be able to tell when progress typically stops, what is incorrect in the students' performance, and what skill elements are omitted. If they are familiar with the skills being taught and know what trainees have gone through up to this point, i.e., are familiar with the earlier training, the personnel responsible for correcting instructional shortcomings can likely spot the source of the difficulty more easily, and

devise corrective measures accordingly. The key is the continued progress of trainees, or their lack of progress. At the time progress stops, it is fairly easy to find out what trainees cannot do. By reflecting on the preceding training activities, the source of the problem can be narrowed down quickly.

The approach to developing measures for correcting training deficiencies taken here thus involved (1) a focus on the entire training program, and (2) a schema for identifying instructional shortcomings and for adapting practice, guidance, and feedback to correct them.

#### ORGANIZATION OF THE REPORT

This report has four major sections of which the present one is the first. Section II presents and explains 15 principles regarding the use of practice, guidance, and feedback. A training analyst should be thoroughly familiar with these principles when he conducts a TPE, determines sources of performance deficiencies, and identifies revisions needed in instructional practices. Section III examines instructional deficiencies that might be indicated by items of evidence listed by HPGI. Ways to pinpoint sources of training problems are explained together with corrective measures that focus on the sources. Section IV discusses five areas of administrative responsibility that are critical to effective training programs.



## II. PRINCIPLES OF PRACTICE, GUIDANCE, AND FEEDBACK

All skill learning is a complicated process. When it is necessary to design a training program, or to find out why an existing program is not as effective as it should be, the complexity of skill learning must usually be considered. In a few instances, the underlying complexity may be no serious problem. The trainees who are to learn the skills may already have had considerable experience in closely related skills, permitting the new skills to be learned easily and quickly. This would not make skills, or their learning, less complex; rather, the experienced trainees would already have gone through the complex process of learning the older skills that make new skills easier to master.

When performance deficiencies occur, however, it means that some part of the complex process of learning has not been provided for adequately. Either special attention must be paid to the entry skill levels of trainees and the training adapted to them, or serious errors in training practices must be corrected. In either case it is necessary to address the process of learning itself. Fortunately, the complexity of learning can be readily understood and managed by thinking in terms of three basic factors that determine learning: guidance--the trainee must be told or shown what he is to do; practice--he must do it; and feedback--he must be able to recognize when he performs correctly and when he does not.

Obviously, guidance, practice, and feedback have to be considered together. Practice, for example, is useless unless the trainee is practicing the right things. It is through explaining and demonstrating how to do a task, i.e., guiding him, that we ensure that he is practicing the right things. He also needs to know how he is getting along. Is he

doing the task correctly? If not, what is he doing wrong? Feedback, properly used, answers these questions.

When training programs are successful, practice, guidance, and feedback are being provided for adequately. When instructional deficiencies become apparent, these three factors are the first things to consider in determining why, and in correcting the deficiencies. Familiarity with the 15 principles discussed in this section should help training analysts understand what should be done in training, and the kinds of instructional shortcomings that can occur. Each principle is numbered for ease of reference later.

#### PRACTICE

For learning to occur, the learner has to do something. When he is doing something specifically to learn a skill, his activities are referred to as practice. For almost all motor skills, hands-on practice is necessary for successful training. However, what a trainee thinks about while he practices is also important. The principles that follow explain important points regarding practice.

1. A person learns to do whatever he practices in the learning situation. If he practices correct performance, he will learn correct performance; if he practices incorrect performance, he will learn to perform incorrectly. It is important therefore for trainees to perform correctly during hands-on practice. Furthermore, if during a lecture or a demonstration prior to hands-on efforts a student practices in his imagination actually seeing, hearing, feeling, and doing what is being talked about or demonstrated, he will build a good conceptual basis for self-guidance as explained later. If instead he practices listening or

observing in a passive manner (or daydreaming), he will learn to wait to be told what to do, how, and when.

2. The total amount of practice should be sufficient to ensure stable criterion skill performance. Generally, practice is insufficient if it is discontinued before criterion performance is achieved at least once. Beyond that point, however, there is no magic formula that says how much practice is enough. Training developers should keep in mind that it is not sufficient for a skill to be performed correctly at one time if it is performed incorrectly at other times. Such variability implies that a trainee has not fully learned the task. The experience of instructional personnel, i.e., of persons who know first hand what the problems are, provides a basis for decisions regarding how much practice there should be.

3. The length and frequency of practice sessions should be adapted to the task being taught, the experience of the learner, and the opportunities for performing the task in the future. One problem here is the role of interference during training. That is, task elements and requirements for correct performance often become confused among themselves. In skill learning, this interference often increases during early practice of an unfamiliar task. This is especially true when the task requires several elements to be coordinated at the same time, or when "branching" is involved, i.e., the performer must make a decision based on cues available as to which of several alternative actions to take. For a while it may seem that every new thing a trainee learns becomes confused with things he learned earlier. In such cases, it is often necessary during early learning to have short but frequent practice sessions on each training task, shifting to quite different types of tasks at the end of a short session. It may also be necessary to practice only parts of tasks at

first. Learners with a good background of experience in similar tasks are not as likely to confuse task elements and requirements, so they can usually practice larger part-tasks and for a longer period of time without a break.

Future opportunities to perform a task help determine how often practice sessions should be. The concern here is retention of the skills involved. If later training activities for other tasks do not in themselves involve the use of a previously learned task, the older task will likely be partially forgotten. Therefore, provisions should be made for later periodic practice of any task that is not performed regularly. (This also holds for proficiency maintenance after assignment to an operational unit.) Again, the experience of instructional personnel provides a basis for deciding how frequent practice should be.

4. Progress should be made during practice. As obvious as this point seems, it is nonetheless ignored in many training situations. Progress is crucial, for if it does not occur, the learner is practicing at least some incorrect performance. Furthermore, because progress should occur, the failure to make progress is the best indication that something in the training needs correcting. This point was discussed in Section I when it was emphasized that causes of training deficiencies can be identified easily and accurately if the training process is observed. Section III will illustrate how this may be done.

Here again, judgments as to whether progress is occurring must be made by instructional personnel, and their experience with similar kinds of training problems provides a basis for making the judgments. A learner may actually be making progress even though it is not apparent at the moment, either to him or to an instructor. The difficulty may be only a temporary

interference. One way to find out is to have the trainee take a five-minute break when progress ceases during practice, and then try again. If progress resumes, fine. If not, it is time to find out what the trouble is. What specifically is wrong? Are the trainees missing cues? Which ones? Are they interpreting cues incorrectly? In what way? Do they know what responses to make? Have they learned to make them? Answers to these questions, which can only be obtained through judgments of experienced instructional personnel, reveal what might have been missed earlier in training and what kinds of changes in teaching practices might be needed.

It may also be found--and this is especially true when complex skills are first being integrated--that trainees have adequate skill knowledge for each task element. It just takes time to put everything together. In such cases, progress may not be apparent immediately; but a rapid burst of progress will follow further practice when skill elements fall into place.

5. The learner should be intensively involved during practice.

Trainees should be led to approach--actually attack--their tasks in full earnestness, for if they practice lackadaisical performance they will learn lackadaisical performance. The number of students being served, and the practice schedules, should not be such that there is idle time during practice sessions, for then socialization and daydreaming compete with learning the task at hand. Furthermore, what the trainees are practicing should be meaningful to them. To maintain motivation and to provide a sense of realism while learning, they should see the connection between what they do during practice and the requirements for job performance. They should make progress toward meeting those requirements during each practice session, and they should realize that progress is occurring. In addition, the

environment for training should reflect an atmosphere of professionalism. The learner is there to acquire important skills, and an instructor's primary responsibility is to help him do so. By each accepting and doing his part well, the learner grows toward a personal professional goal that is valuable to the Army; and the instructor fulfills a personal professional goal of being a successful teacher while doing a job of critical importance for military readiness. (Section IV pursues this topic further.)

Involvement of the learner during practice depends on all these conditions, including an instructor who takes personal pride in quality teaching.

#### GUIDANCE

Guidance means directing a learner's response. The response may be a muscular action such as driving a tank, a perceptual action such as scanning a terrain for a target, or a mental action such as interpreting a cue or making a decision. Guidance is involved whenever a learner's attention is directed to what movements to make, what to look for, or how to interpret a cue or make a decision. Guidance is also involved when a learner is told what not to do.

The purpose of guidance during training is to focus a learner's attention on what to do and how to do it, and to help him avoid inappropriate and incorrect actions. If he practices only correct actions, he can learn only correct actions; and if he avoids incorrect actions, he will not learn to make them. This point cannot be taken to the extreme. Some incorrect actions will occur, and often they can contribute to effective training. Skill mastery requires not only knowing what to do, but also what not to do. There are times when experience doing the wrong thing teaches the

learner not to do it. It is crucial, however, that the student know immediately when an action is incorrect (see the following discussion of feedback).

The principles that follow explain important points regarding the use of guidance.

6. Guidance is needed when the learner cannot determine a correct action on his own. Generally, this means that guidance is most valuable early in learning when the student is most likely to miss pertinent cues and make incorrect or inadequate responses. For the same reason, guidance is useful later in training when practice begins on a new task. It is also useful at any other time when it is apparent that the student is unable to progress on his own.

7. Guidance should direct the learner's attention to individual cues and specific performance requirements. It is not sufficient just to describe or demonstrate a skill; the learner should be directed to note those specific things that make the difference between correct and incorrect skill performance.

8. Verbal knowledge from classroom instruction, text materials, memory aids, and job aids such as equipment manuals should be presented, and their use practiced, in ways that capitalize on their guiding value. Classroom instruction should focus on verbal knowledge the trainees can understand and put to use during hands-on practice. Presentations of topics and aspects of job performance that they cannot understand at the time should be delayed until trainees have acquired the experience needed to understand them. (Audio-visual aids can help provide meaning, as can previous experience with training or operational equipment.) Training materials should be designed not just to lead a student through a task, but to focus his attention on critical aspects of skill performance.

9. Guidance should not be used when it is not needed. If a learner receives too much guidance, he learns to depend on guidance instead of on himself. Therefore, guidance in the forms of lectures and demonstrations should be given routinely only at those points during training when all students are likely to need it. Additional guidance should be on an individual basis, and then primarily when a learner stops making progress, or for final "polishing" of a skill.

10. Self-guidance should be a specific goal in all training. A self-guided performer is what is meant by an independent performer. It means that he can direct his own actions, recognize and correct his own error tendencies, and that he is competent in the skill generally. The self-guided, independent performer has to understand what he is doing. While we teach for this goal, we seldom spell it out in this manner. We are more likely to achieve truly independent, self-guided skill performance if we do define it as a goal so that it is always in mind. Training for understanding can then be designed for a clear purpose.

#### FEEDBACK

As necessary as practice is for learning, its value depends entirely on what happens while practice occurs. One learns a skill not by just trying to perform it, but by finding out which attempts are correct and which ones are not. In other words, the learner must receive information--feedback--that lets him know what is correct in his actions and what is not. Otherwise, there is no basis for continuing correct actions and dropping out the incorrect ones. The learner would not know the difference.

Depending on the newness of the task to be learned, and on the previous experience of the learner, a trainee may be able to recognize when a



skill has been performed correctly. As a rule, however, there will be many aspects of the skill that he cannot judge at first. For this reason, an objective of every successful training program, whether recognized or not, is that the trainees learn to provide their own feedback, i.e., to recognize the difference in what happens naturally when a skill is performed correctly and when it is not. Furthermore, they must be able to recognize the feedback while performance is going on so that timely adjustments in performance can be made.

While acquiring this ability, the trainee will need a lot of help. An instructor may have to tell him what is right and wrong, and point out what the trainee should notice, i.e., guide him, so that he can learn the feedback himself. In many training situations, and especially during hands-on practice, such individual attention will require small trainee/instructor ratios. Many modern training devices can substitute for an instructor in this role, and in some cases do a better job because they can monitor what trainees do more closely and accurately than an instructor can.

Accurate and timely feedback is so crucial to successful training that deficiencies in student performance following training almost always result when feedback is inadequate. One must watch progress during training, and identify what goes wrong and when, to determine whether feedback is misused and how it should be adapted. The problem often reduces to instructors' having too many trainees to work with individually (see Section III), but probably the more common difficulty is that instructors do not know how important feedback is nor how to provide it.

The principles below summarize some of the most important aspects of feedback in training.

11. Feedback should be specific to the response. If feedback is to let a learner know whether he is right or wrong, he must be able to tell

which response is right or wrong. If all responses are correct, of course, telling a student that he performed the entire task correctly also tells him that each response was correct. But if errors occur, a general statement that he "did it wrong" does not tell him what parts of his actions must be corrected. He needs to know what was right and what was wrong.

12. Feedback must occur while the learner still remembers clearly what he did. In practicing new tasks especially, trainees often are groping and do not realize exactly what they are doing. Responses may be simply of the wrong sort. They may be too slow or too fast, too weak or too strong, too early or too late--or even omitted. Except for omissions, the trainee may have no clear memory a few seconds later of just how he responded; and if not, he would need feedback without any delay. To the extent he can remember how he responded, delays in feedback are of no great consequence.

13. When the ongoing coordination of an action depends on continuous feedback from each part of the action, no delay in feedback (other than that characteristic of operational performance) can be tolerated. In such cases the feedback, often through the "feel" of an action, is a cue for the next immediate response. Necessarily, the next response cannot be initiated until its cue occurs. (This principle is of primary concern when simulators of actual equipment are used for training motor tasks. A need for realistic natural feedback may require a degree of equipment fidelity that is not necessary for tasks where visual-motor coordinations are not crucial.)

14. Feedback should be provided in ways that help the learner see when he is making progress. In many cases the trainees will be able to recognize progress because they can see for themselves when they are improving. This is especially true when feedback that occurs naturally as

a result of actions can be correctly interpreted by them. It is also true for simple sequential procedural tasks when trainees have memorized the steps or when a checklist is available, for then they can check what they do against their memory or the list. But in many other cases, novice trainees especially cannot recognize when they are improving, even in procedural tasks if they involve interpreting subtle feedback cues. In these instances, trainees must be told when they are responding correctly, either by an instructor or through automated monitoring by a training device. And at some points, they will need instructor recognition of their progress to maintain motivation. If the instructor cares, if the progress is valued by others, trainees are more likely to care themselves and remain intensively involved in the learning.

15. When errors are made, or when there is little or no progress in skill acquisition, the feedback should focus on correcting the difficulties, not punishing the learner. This is one respect in which the professionalism of instructional personnel as mentioned earlier is crucial. If they see their responsibilities as helping trainees and supporting their learning efforts, they will use feedback only to this end. That is, they will correct mistakes in ways that the trainees can recognize the instructors' concern for their welfare. Punishing, humiliating remarks by instructors are never interpreted by trainees as helpful. Reprimands may be appropriate when trainees are goofing off, but they can never help, only discourage, when they are trying.

#### SUMMARY

Fifteen principles regarding the use of practice, guidance, and feedback were presented and explained. These principles will be referred to often in the next section because they underlie both the identification and the correction of shortcomings in instructional practices.

### III. IDENTIFYING AND CORRECTING INSTRUCTIONAL DEFICIENCIES

This section examines common shortcomings in skill training that arise during instruction. The HPGL report listed more than 20 such training deficiencies. Each of these deficiencies is covered in one or more of 20 instructional shortcomings discussed below. While the discussions apply to individual trainees having difficulties, problems will be of concern for present purposes only if the deficiencies characterize a large enough number of trainees to require revisions in training practices, not just special help for individuals.

In line with a point emphasized in Section I, and again when practice was discussed in Section II, failure to progress during practice is the most common focus for identifying instructional deficiencies. For the first 14 deficiencies, steps for corrective actions are outlined in terms of amount of practice, the practice schedule, and/or what is being practiced. Guidance and feedback are discussed as appropriate in connection with the provisions for practice. The dual role of practice as a determiner of learning in and of itself, and as a "vehicle" for productive uses of guidance and feedback, should thus be evident.

Issues of practice are not directly involved in the last six deficiencies. They are concerned with guidance and/or feedback independently of the practice formats. Their identification and corrections will be discussed accordingly.

The discussion of the first instructional deficiency immediately below describes a general scheme for identifying sources of deficiencies. Five "symptoms" of training problems are identified, each of which is

discussed as it applies specifically to the absence of sufficient hands-on practice. Also, the implications of various symptoms for inadequate uses of guidance and feedback are indicated. To avoid unnecessary repetition, later discussions will frequently refer back to this scheme for the identification of symptoms, and in some instances for their interpretation. Additional indicators of instructional deficiencies and their interpretation will be introduced as they apply to each of the other sources of training deficiencies.

1. There is an Absence, or an Insufficient Amount, of Hands-on Practice During Training

This deficiency becomes obvious when (1) no hands-on practice is provided at all; (2) trainees do not know what to do in the presence of suitable cues; (3) their performance is unduly variable from one trial to another; (4) they are unduly slow in performing a task; or (5) they depend too much on job aids and memory "joggers."<sup>1</sup>

The presence or absence of each of these indicators helps determine what is needed. If trainees receive no practice at all it obviously should be provided. If they receive some practice but still do not know what to do, guided practice is needed (Principle 6). If performance during practice or on a test is unduly variable, there has not been enough independent

---

<sup>1</sup> An instructional deficiency also exists when, after being away from a task for a while, trainees cannot remember how to do it although they performed the task adequately during earlier practice. This deficiency may not relate to the formal training program per se, but it does indicate that additional training is needed. If previously learned skills have been forgotten, they obviously need periodic practice (Principle 3). Such practice can be arranged at intervals, with intervals not so long that forgetting from one practice occasion to the next results in serious skill deterioration. It may also be feasible to find ways to incorporate the skill into the practice of other skills, but the other approach would generally be less disruptive of an established training routine.

practice, and/or the trainees have not learned to interpret natural feedback so as to correct erroneous response tendencies before they disrupt smooth, consistent performance. Provide additional practice and note whether progress is made (Principle 4); if not, provide guidance as needed to help trainees identify appropriate feedback (Principle 7) and then continue practice without guidance until correct performance stabilizes.

Unduly slow performance during practice or on a test can be due simply to not enough practice, or to an excessive dependence on unnecessary "crutches" (e.g., checklists used as training aids). If the former, provide additional practice; if observation reveals the latter to be the case, withdraw the "crutches" (Principles 9 and 10). The last statement also applies to the fifth indicator above concerning too much dependence on performance aids.

The steps involved in correcting these deficiencies thus depend on their source. The general scheme is to (1) provide practice if none is given, and additional hands-on practice if that given is not sufficient; (2) note whether trainees progress steadily to a desired level of performance; (3) if not, provide minimum guidance for responses and for interpreting natural feedback cues; (4) withdraw guidance and continue practice, using additional guidance sparingly and only when the trainees cannot progress on their own; and (5) revise training procedures to conform to the changes so as to achieve accurate, stable performance.

## 2. There is Inadequate Integration of Academic and Hands-on Training

This deficiency often is due to relying on lectures when hands-on practice would be better. Insofar as lack of sufficient hands-on practice is the problem, this deficiency is essentially the same as the one discussed immediately above, and the same corrective steps are involved.

A second source of this deficiency is the frequent separation of content for academic and hands-on training. That is, one kind of subject matter is covered during lectures, and a different kind during skill practice. The understanding trainees acquire should directly support, and be usable in, actual skill performance. Verbal knowledge and hands-on skills should form a coordinated, mutually supporting base for skill achievement. (See discussions of Principles 8 and 10.) Training therefore should focus on both, slighting neither, and with the goal of maximum utilization of understanding while performing tasks.

A problem in the integration of academic and hands-on training can be identified in two ways. First, an examination of the content of academic instruction will reveal to an experienced training analyst or subject matter expert whether it is relevant to skill performance. Second, observing trainees during practice as just discussed can reveal lack of adequate understanding of skill requirements. (See especially diagnostic step 1 regarding trainees' not knowing what to do in the presence of suitable cues.) If inadequate academic content is the problem, an analysis should be made of the knowledge needed to perform properly--relevant cues, contingencies for actions, responses to be made, standards for performance--and lectures and demonstrations revised accordingly (Principle 8). Given adequate academic content, then the diagnostic-corrective steps summarized at the end of the discussion of the preceding topic should be followed.

### 3. Session Times Are Inadequate for Objectives

This deficiency may occur because too much is attempted in the training program, or because of inefficient training methods and conditions. If the problem is that too much is attempted, the solution is obvious. A systematic analysis is needed to establish reasonable training goals and priorities (see Section IV).

If inefficient training methods are the culprit, it means that progress during training is slower than it could be. All training should be monitored, and tasks and stages of training where trainee progress is unduly slow should be noted. Diagnostic studies as described earlier should be made if needed, and corrective actions should be taken as indicated. There are so many possible inefficient training methods that it is not practical to pursue them further here. However, all other training deficiencies discussed in this section involve inefficient training practices which in many cases tend to extend the time required for training. The reader is referred to the other discussions for things to look for while observing trainee progress, how to interpret what may be found, and how to correct instructional shortcomings.

#### 4. Practice Activities Lack Realism

Realism can be lacking for a number of reasons. At one extreme, tasks that depend on physical actions and sequencing and coordinating responses may be taught largely through verbal description. If so, the discussions under Topics 1 and 2 above are relevant: Hands-on practice should be provided as needed to achieve stable correct performance, and the verbal knowledge should be integrated with the physical actions involved in performance.

Realism is a broader issue than this, however. First, efficiency in training typically requires instruction under conditions that do not hold during testing. For example, demonstrations and artificial feedback are used during training; performance during practice can be interrupted to focus instruction on particular points; mistakes can be easily "forgiven"; etc. During a test, however, the student is on his own, performance must progress realistically, and mistakes are counted against the performer.



Furthermore, just the fact that a test is a test makes it different from most training activities in the perception of trainees.

A training program should recognize these differences and prepare trainees not only to perform skills, but to perform them under conditions that will hold during testing. Generally, a "dry run" is called for prior to the test itself so that skills can be interfaced with test conditions.

In the absence of a dry run or a comparable means for adapting learning to test conditions, the training analyst can have difficulty ascertaining the source of a performance deficiency on a test, and hence prescribing a correction. It makes a difference whether the foundation training was adequate and test failures were due to lack of opportunities to adapt to the test situation, or the foundation training itself was faulty. If the former, the correction requires only a dry run or equivalent; if the latter, diagnoses of shortcomings in all aspects of the instruction may be needed (see first topic above).

A second problem concerning realism is becoming more and more prevalent in military training. Specifically, equipment designed to exploit principles of training technology, and to reduce training costs, often differs from operational equipment in physical and functional characteristics. If trainees practice with such equipment but are tested on actual equipment, the interfacing of skills learned with testing conditions becomes critical. More than a single dry run may be needed before trainees can demonstrate what they actually learned. Thus, identifying the source of a test performance deficiency is more involved, and it usually requires expertise in training evaluation. Such analyses are beyond the scope of the present effort, but TPEs in the near future may well have to expand to include them.

5. There is an Absence, or an Insufficient Amount, of Integrated Practice

A learner may have mastered every part-task that, taken together, make up a whole task, but still not be able to perform well on the whole task. The problem concerns what is being practiced, and how much. Principle 1 is clearly relevant: A trainee cannot learn to integrate parts of a task unless he practices the integration itself. Therefore, integrated task performance itself must be practiced. Furthermore, integrative practice must continue until the integration is stable and can be retained (Principles 2 and 3).

To identify this training deficiency, determine (1) whether trainees practice the whole, integrated task; (2) if so, whether there is steady progress to a desired proficiency level; (3) whether whole-task skills once achieved are retained; and (4) if original whole-task skills are not retained, identify which part-tasks (if any) are forgotten.

If too little practice is the only problem, then progress will be steady during the practice that is provided for the whole task. If steady progress does not occur, refer to earlier discussions of insufficient hands-on practice for ways to identify inadequate uses of guidance and feedback. The present problem is exactly the same except that integration of performance is the "task" to be learned.<sup>1</sup>

(If the separate skills of a complex task have been mastered, their integration into a complete task, once mastered also, will usually be retained fairly well. Integration imposes an organization on the task, and organization is a primary basis for retention. Sequential tasks such as those

---

<sup>1</sup>The fourth step immediately above, while implicit in the earlier discussion, is explicit here for reasons apparent in subsequent discussions.

involved in many procedures may not acquire a high degree of organization even when they appear to be fairly well learned. To aid retention, it is necessary that parts of a sequence depend on each other in their execution. The fact that one step follows another in a procedural task does not necessarily make the steps depend on each other in trainees' understanding. Therefore, procedural skills may be forgotten if not practiced periodically.)

How much practice in integration is needed for learning to take place is revealed by trainees' progress during integrative practice. After proficiency is first achieved, additional periodic practice may well be needed for retention (Principle 3). The experience of instructional personnel with training the tasks involved can often provide bases for judgments regarding the amount of additional practice needed. But two points should be remembered. First, if a skill that was well integrated earlier in training has deteriorated to the extent that recovery is slow, the problem is probably due to the deterioration of skill components--various part-tasks--not to a substantial loss in the integration itself. Second, during training, sequential skills may not achieve the true integration required for retention, so periodic practice may be necessary to assure correct performance on a final test.

The learning of task integration requires less total practice if integrated practice begins early, i.e., if separate part-tasks are not practiced longer than necessary. As soon as progress in integration can be made (Principle 4), larger and larger groupings of part-tasks should be practiced together in the manner in which they must be performed on the job. It will also aid later integration if, during earlier practice of each part-task, trainees are made constantly aware of the total context in which the part-task must be performed (see discussion of Principle 5).

They should be reminded as often as necessary to think about overall task requirements while practicing a part-task.

The steps for correcting a deficiency involving the absence, or an insufficient amount, of integrative practice are, then: (1) provide integrative practice, and do so as soon as part-tasks have been learned well enough for steady progress in integration to be possible; (2) monitor integrative practice to ensure that progress is maintained up to an acceptable level; (3) if progress is disrupted, identify the troublesome part-tasks involved and provide additional part-task practice as necessary; (4) determine for the whole task and for part-tasks whether additional periodic practice is needed after original proficiency is achieved so as to assure retention of the complete skill; and (5) revise the training schedule accordingly.

#### 6. Step Sizes Are Too Large

Step size refers to the number of task elements that are presented at one time, or to the complexity of cues and responses that must be recognized and performed precisely in a step. Difficulties arise when trainees cannot deal with all the task elements, cues, and responses simultaneously. In other words, they are required to do more than they are prepared to tackle at the time.

Step sizes that are too large can introduce a number of problems. When they are being demonstrated, trainees can easily confuse task elements, and forget cues and required actions before they have a chance to practice them (see discussions of Principles 7 and 8). If too many new things must be done at one time or completed quickly as a sequence, it may be impossible to provide feedback for specific acts, or as soon as it is needed (Principles 11 and 12).

The identification of step sizes that are too large is straightforward: (1) observe the points during hands-on practice where trainees have undue difficulty just getting started; (2) determine whether prior guidance, oral, written, or by demonstration, was provided; and (3) question the trainees to determine what confused them and when, or whether they understand any of it.

While the result of (1) is all that is needed to determine what step sizes are too large, (2) and (3) help determine what to do about the problem. It is possible, of course, that the last two diagnostic actions will reveal deficiencies in guidance and in timely, specific uses of feedback that, when corrected, will remove the difficulty. In other words, step sizes may not be too large if care is taken to be sure trainees get the help needed for each element.

If it appears that improved guidance and feedback cannot solve the problem, then step sizes should be adjusted. Either task complexity at given points should be temporarily reduced, or smaller segments of the sequence of task elements should be practiced separately. In either case, the result is to focus practice on part-tasks. It is important, however, that the separate part-tasks be properly chosen. First, any part-task grouping must make sense so that the separate elements can be organized meaningfully. The integrity of the part-task and the task as a whole must not be compromised. Second, as discussed under Principle 3, the problem is largely confusion of cues and response requirements (interference), so part-tasks should be such that confusion is minimized during early training. Third, part-tasks should be small enough for trainees to remember the details of any guidance they receive. Fourth, task elements included in a given step should be easily distinguishable, by the instructor and by the trainee, for purposes of specific, timely feedback

(Principles 11 and 12). Fifth, the past experience of the trainees should be considered in organizing part-tasks for practice (Principle 3). When possible, each part-task should contain elements for which the trainees already have some proficiency, plus elements that are new to them. The ability to perform portions of a part-task well will help in learning the unfamiliar portions. Finally, of course, the entire task should be practiced as a whole (see earlier discussion of task integration).

The steps for correcting this deficiency are, then: (1) identify groupings of task elements that do not compromise the integrity of the task, and that capitalize on trainees' past knowledge; (2) redesign the demonstrations to provide specific guidance as discussed; (3) redesign feedback to focus on separate task elements; (4) observe progress during practice to ensure that desirable learning is occurring; (5) to check adequacy of the new task steps, determine if trainees, after a reasonable amount of practice, can perform each step unaided (Principle 10); and (6) provide for recombining part-tasks for practice in larger units, or as a whole task, as soon as progress can be made on the larger units.

#### 7. Complexity or Novelty of Tasks is not Considered from Trainees' Viewpoint

"Complex" tasks are those requiring fine visual discriminations, precise motor skills, high rates of performance, and/or long series of steps to be recalled. "Novel" tasks are those for which trainees have no relevant prior experience.

A point to bear in mind regarding either task complexity or novelty is that, from the standpoint of task performance, no task is complex to an expert in the task or novel to a person who has relevant prior experience. Conversely, all tasks are complex to the extent a person has not learned the skills involved, and are novel when encountered for the first time. The

reason for these statements is to emphasize that the same principles of learning are involved regardless of task complexity or task uniqueness, and that trainees' previous experience should be a major factor in devising training techniques. In a few cases, it may be clear from past experience in teaching a skill or others similar to it that the approach used in a given training program was inadequate. In most cases, however, better diagnostic information will be needed and it can be obtained by observing trainees' progress as has been emphasized in foregoing discussions. The analytic steps described for deficiency 1 are applicable to the present problem. Similarly, the use of part-task training as described immediately above for adjusting step sizes, and the integration of part-tasks as discussed earlier, are clearly relevant as approaches to training complex and novel tasks. As pointed out in all these discussions, the skill elements and stages of training that are troublesome must be identified, and disruptions in performance--or failure to make any progress--is the clue.

The corrective steps to be taken would be determined by what was observed during the monitoring. In most cases, part-task training will be needed to break the complexity down into manageable units (see earlier discussion of step sizes). If the complexity derives from fine discriminations among competing cues and types of natural feedback, or from difficult coordinations of actions, special part-task training (or training devices) should focus on them. Novel tasks also may need to be broken into small steps. Guidance may need to be more detailed and given more often than for other tasks, and the instructor may have to provide feedback himself while the trainees are learning to recognize and interpret natural feedback.

#### 8. Training is Geared Too High for Trainees' Entry Knowledge and Skills

If trainees entering a training program do not have the background it

was assumed they would have when the program was designed, they will have undue difficulties during training. This is primarily an administrative problem in that a redesign of the earlier stages of training is needed (see Section IV). In the meantime, however, trainees will need special attention. The point to bear in mind is that no new principles of training are involved. The 15 principles given in Section II apply to all levels of previous achievement and ability. The special attention referred to involves adapting the principles to take care of unanticipated trainee weaknesses.

The corrective steps depend to some extent on the reasons for low entry skills. There are two general reasons: a lack of requisite prior experience, and low aptitude for the skills to be learned. Two general types of diagnostic efforts are needed. First, experienced training personnel should review trainees' records to pinpoint as much as possible the nature of their backgrounds and general level of aptitude. Formal and informal discussions with entering trainees would help clarify possible gaps in requisite experiences. Also, formal or informal proficiency tests covering required beginning skills would reveal specific deficiencies.

The second type of diagnostic effort would concentrate on how the trainees actually progress during training. The general scheme for observing practice discussed for deficiency 1 should be followed. Interpretations of the observations would focus specifically on indications of inadequate experience versus low aptitude. Inadequate experience is indicated when trainees can progress normally after remedial training to provide the missing skills. Low aptitude is indicated when progress is unduly slow regardless of remedial training. (It would also be slow during remedial training.)



To the extent the problem is due to inadequate requisite experience, corrections would typically involve providing the needed experiences before training begins, or later in training just so long as the remedial training is given before the requisite skills involved are to be used. In some cases, special training techniques may remove the need for remedial training, i.e., the deficiencies can be overcome while the regular tasks are being taught. For example, trainees may not know how to use particular tools required to perform a task; but they may be able to learn to use the tools while practicing the task, so remedial practice with the tools alone would not be necessary. However, alterations in usual teaching procedures would likely be required. The types of changes involved would be generally the same as the adaptations needed for trainees of low aptitude, the topic of the next paragraph.

To trainees of low aptitude, and to those who participate in regular training even though they do not have certain requisite prior experiences, the skills to be taught will appear quite complex, even novel. Therefore, the earlier discussion of these topics is relevant here. Step sizes are likely to be critical, and steps that are too large should be a special concern while monitoring progress during practice. It is also likely that demonstrations, and overviews presented at the beginning of training sessions, were designed with higher entry level skills in mind. If so, they will probably need immediate revision. Instructors should assume less ability to understand and simplify their presentations accordingly. It is also necessary that customary ways of providing feedback be reviewed carefully. Trainees with low entry skills will surely have difficulty profiting from feedback that is not highly specific and timely (Principles 11 and 12). They will also need more guidance in learning to recognize and

interpret feedback that occurs naturally during task performance (Principle 7).

Finally, these trainees are likely to be sensitive to the interference that builds up during early stages of learning, so practice schedules should be carefully adapted to ensure steady progress (Principles 4 and 14). And, of course, practice should be closely monitored so that difficulties can be identified without delay. Many of these trainees, especially those of low aptitude, will be easily discouraged when they are making no headway. It is critical for them to stay intensively involved (Principle 5).

The steps for alleviating this training deficiency, then, are: (1) determine the reason(s) for low entry skills; (2) provide preliminary remedial training as needed; (3) follow procedures for reducing step sizes and complexity and novelty of tasks discussed earlier; (4) revise uses of guidance and feedback as needed to make them specific, timely, and meaningful; (5) adapt practice schedules and monitor progress closely to identify and correct difficulties as soon as practical after they arise; and (6) initiate a revision of the training program so that tentative corrective steps can be thoroughly integrated into a systematic program (see Section IV).

#### 9. Job Aids Needed But Are Not Used in Training

If aids are to be used on the job, and students are expected to know how to use them upon completing training, students should practice using them while training. This deficiency results from simply ignoring Principle 1: Trainees have to practice a skill to learn it. If the use of job aids is not practiced, their use cannot be learned. Instructors often slight job aids even when they are included in training, perhaps preferring to use limited time on less mechanical aspects of performance. They may

feel that job aids can be learned on the job. Also, some instructors appear to believe that true learning requires that everything must first "be in the head," that job aids are all right as reminders but should not substitute for knowledge. The result is that students often have to memorize by rote the information contained in job aids--and rote memory is notoriously unreliable.

It is easy to determine if a given job aid is not used at all: Observe the instruction, ask the instructors if they use them, and/or determine if the trainees even know what they are. If job aids are included in training, the adequacy with which trainees learn to use them is easily assessed by observing them during practice: Do they know when to use them? Do they use them correctly? Are they properly integrated with the tasks to which they relate? Assuming trainees learn to use them satisfactorily while training, can they use them later during the test? (This last question concerns relatively short-term retention. While it could be asked regarding any instructional deficiency discussed, it can be especially important where job aids are concerned. Job aids often involve rote learning of procedures rather than full understanding of the factors involved. Rote learning is very unstable without periodic practice. Even if the test is delayed only a few hours or a day, significant forgetting can occur, and additional practice may be needed.)

Some general comments regarding practice and guidance are also in order. First, as with any other skill, guidance is usually needed in learning to use a job aid, so Principles 6, 7, and 8 are clearly applicable. Many job aids include instructions for their use, in which case it is necessary only to assure that trainees can follow the instructions. (Some additional guidance may be needed, however.)

Second, trainees should eventually demonstrate ability to use the aids without help from other sources (Principle 10). Third, periodic practice using the training aids will probably be needed if trainees use them mechanically with little understanding of the relation of the aids to equipment functioning and task performance.

The correction of this training deficiency is simple: (1) determine which aids are to be used during the final test, i.e., are to be mastered during training; and (2) for those aids whose use is included in the test, provide sufficient practice during training to assure the proficiency desired.

#### 10. Trainee/Equipment Ratio Is Too Large

The concern here is that the training equipment available may not be sufficient in amount for trainees to get the hands-on practice needed. This is essentially a matter of insufficient hands-on practice which was discussed earlier (deficiency 1), and the scheme presented there for determining whether enough practice is provided applies here. The identification of the problem is more straightforward, however. If progress continues so long as trainees practice, but trainees do not reach criterion achievement levels or remember what they learn, then there has not been enough practice. And at the same time, if training equipment is being utilized fully, there is not enough training equipment, at least for the training program as designed. (In the extreme case, some trainees may not have the opportunity for hands-on practice at all. In such a case, it is obvious that more equipment is needed.)

Obtaining a desirable trainee/equipment ratio is primarily an administrative matter. More equipment can be procured, class sizes reduced, or training time increased. Nevertheless, more efficient use of available equipment often can relieve some training problems.

A common barrier to solving, or at least alleviating, this problem is an insistence on a lock-step training regimen: All students in a class are expected to learn the same things at the same time. The program is planned as a series of training events, and the sequence of skills practiced has to be the same for all trainees. Therefore, there is a high demand for every type of equipment when times come for everyone to use each type. If there must be a standard sequence, and if equipment is in short supply, students might enter the training at staggered times rather than as complete classes.

However, the training could be planned so that different trainees could be doing different things at any one time. It would be necessary to ensure that prerequisite skills are learned in sequence, but even with this restriction it is usually possible to have alternative tracks within a single training program. (There may be additional demands on instructional personnel, however.) Part-tasks as discussed earlier offer a number of opportunities for alternative simultaneous training activities. Also, some relief from demands on training equipment can often be obtained by using proficiency advancement, i.e., letting a trainee stop a given type of practice when he first shows adequate achievement, beginning him on a new task, and turning the equipment over to another trainee. Proficiency advancement requires monitoring each trainee, or small groups of trainees, which can be time consuming; but with experience the extra responsibility would generally be negligible. Trainees could even monitor themselves in many cases, and call on an instructor only when they think they can demonstrate skill proficiency.

Principles 2, 3, and 4, taken as a whole, can ensure quality training in a proficiency based program or one with alternative tracks: Practice

must be sufficient for learning and retention, but the amount can be adapted to the learner's need; and practice can occur according to varying schedules--durations and frequency--so long as adequate progress in learning is maintained.

#### 11. Training Materials Are Poor or Inaccurate

The most common sources of this difficulty are dated (obsolete) lesson plans, equipment manuals, and job aids; dated or otherwise inappropriate training equipment; and otherwise appropriate training equipment that is in such poor repair that it does not function as real equipment does, or that has been used so much that cues have been made unduly obvious. When these conditions exist, instructors must either use training materials as they are or devise their own alternatives. Neither approach is desirable.

These problems are primarily administrative matters, and they are discussed in Section IV. Nevertheless, some stopgap measures are possible. Determine which available materials and equipment can be used successfully and which cannot. Rarely is an entire manual dated, for example, unless the equipment has been completely changed. And even dated or poorly maintained training equipment may still be usable for teaching some skills. In any case, any discrepancies between training and operational materials should be clearly explained to the trainees, and some practice should require them to recognize which parts are applicable and which are not. If the equipment is to provide feedback, it should be used only for those tasks where correct and incorrect actions can receive feedback accordingly (Principle 11), and where the feedback can be provided in a timely manner (Principles 12 and 13).

#### 12. Training Becomes Boring

Boredom may be due to the instructor's manner of teaching or to the length of practice sessions. Also, some tasks are plain tedious. Even

though many tasks will remain boring on the job, there are good reasons for avoiding boredom during training.

Boredom is indicated when trainees not only stop progressing during training, but go downhill. They become careless, forgetful, and are easily distracted. If boredom is due to the task, most instructors will have bored trainees when the task is practiced, but not when certain other tasks are being taught. If the instructor is the problem his trainees will tend to be bored regardless of the task, while trainees under other instructors will be bored less often. An additional factor should also be considered. It is not uncommon for trainees to be required to practice tasks after they have achieved proficiency on them. This is likely to occur when all of the trainees are expected to practice each task according to a rigid schedule. Trainees who learn rapidly or who begin with high entry levels of similar skills must thus continue practice even though it is not needed. These trainees will likely go through the motions with a minimum of attention and involvement.

Boredom is detrimental to training. The trainee is not properly involved (Principle 5), and lackadaisical performance is likely to be practiced and learned (Principle 1). It does not matter that the trainee will later be bored on the job too. The idea is to practice, and learn, a skill. Boredom does not have to be learned, so no practice is needed for it. Training can come to grips with tedium after trainees have acquired the skills needed to do their jobs.

If boredom is due to previous mastery of the skills, it can be easily avoided by permitting proficiency advancement (see earlier discussion of trainee/equipment ratio). If the boredom is due to the instructor, the discussion of instructor qualifications in Section IV is pertinent. But

whether due to the instructor or the tedious nature of tasks, boredom may well be reduced by careful planning. Several types of adjustments might be made. (1) Practice can be arranged so that boring tasks are pursued during a given practice session only as long as needed to ensure regular progress from one practice session to another. (2) Tedious and interesting tasks can be practiced alternately. (3) An atmosphere of operational realism can be introduced into the session. (4) Elements of challenge can be introduced through competition among trainees, teams of trainees, or competition of each trainee with himself to surpass earlier performance. (Competition is a more effective motivator when every trainee has a reasonable chance to "win," and when there is a formal recognition, tangible or otherwise, of superior performance.)

These approaches focus on ways to avoid boredom by beneficial arrangements of practice and practice conditions. Even with ideal practice conditions and schedules, however, some tasks will remain boring. Maintaining motivation can overcome the boredom that cannot be avoided.

Students are likely to stay motivated and involved during practice if they recognize that they are making progress toward a valued goal (Principle 5). If they cannot recognize this progress themselves, instructors or automated feedback systems in training devices should help the students recognize when they are progressing (Principle 14). In addition, the instructor, not a device, should encourage the student by recognizing his progress (see discussion of Principle 14); and when corrections are needed, the feedback should be given in a supporting, not punishing, manner (Principle 15). By the example of their instructors, and with instructor understanding and encouragement, trainees can learn to accept tedium and adjust to it constructively. A general atmosphere of



professionalism (see discussion of Principle 5) is conducive to this acceptance and adjustment.

### 13. Training Schedule Is Interrupted

For a variety of reasons--equipment breakdowns, temporary unavailability of instructors, delays due to weather--interruptions in training may well lower final achievement unless their effects are corrected.

Whether a training schedule has been interrupted is easy enough to determine. The effects of the interruption are the issue. Overall training plans should provide guidance for dealing with likely interruptions, and bases for such guidance are the concern of this discussion.

The first task is to anticipate the kinds of difficulties that might result from an interruption. Many problems can be overcome by an oral review of the training completed prior to an interruption, accompanied perhaps by demonstrations of key skills. It may also be desirable to design a practice session in which the students actually perform the earlier skills. If serious disruptions in performance occur, additional practice on troublesome skills can then be provided. If there are good reasons (based on experience, for example) to expect no serious disruptions in performance, the oral review, possibly with demonstrations, may be adequate, in which case training can pick up where it left off. But regardless of what corrective steps might be used at first, subsequent practice should be monitored by the instructor to assure progress as discussed under deficiency 1.

The steps are: (1) review what was covered during the training prior to the interruption, using demonstrations when needed; (2) provide diagnostic practice if it is anticipated that appreciable forgetting has occurred, and follow up with additional practice on troublesome skills if

and as needed; (3) continue training from the point of interruption; (4) monitor the subsequent training to see whether additional review and corrective practice are needed; and (5) provide additional corrective instruction as indicated.

14. Trainees Forget Much of What They Learned When There is a Long Interval Between Training and Testing

The clue to this deficiency is that there was a fairly long break between the end of practice on a particular task and the test, and that trainees could not perform skills on the test that they could perform at the time they practiced it. An obvious remedy to this deficiency is to reduce the interval so that fewer events will interfere with retention. A test administered immediately following practice will indicate whether the task had been learned at all, even if it may be soon forgotten.

This problem probably should be viewed in a broader perspective, however. If skills are forgotten during a relatively brief period that elapses between practice and being tested upon completing training, not much is likely to be remembered after assignment to a field unit.

There is a difference, of course. Training programs are designed to provide, and quickly, a foundation upon which experiences can build. The foundation is seldom comprehensive and thorough enough to stand alone. Trainees must later encounter situations in which skills can repeatedly be put to use if the original foundation is to serve its purpose. Opportunities to use some skills may not arise for some time. Therefore, the test following practice can address only the original foundation, not the accumulation of experiences necessary to build full skill competence.

Thus, the problem reduces to what the test is to reveal. If it is to establish that the students reached a given level of proficiency, however

"temporary" it might be, it should be given immediately following training. If the test is unduly delayed, it simply makes the test results less useful for this purpose. After all, delaying a test cannot of itself render adequate training inadequate.

If delayed tests are to be used to assess training achievement, provide periodic practice during the delay for those skills that tend to lose precision (Principle 3). Then poor test results can be interpreted as an actual instructional deficiency.

#### 15. Overviews Preceding Practice Are Inadequate

A preliminary overview of a training session can help trainees by directing their attention to the actions to be learned, and to the cues and natural feedback accompanying the actions. If an overview does not accomplish this purpose, efficiency of training suffers.

An overview is a guiding process. If it is not adequate, trainees will not know what they are to do (or understand--overviews are needed for lectures). They will miss cues and natural feedback, and not be clear at first on what they mean even when they are pointed out. Inadequate overviews, therefore, are indicated by unnecessary floundering during practice, and by the need for an instructor to provide unusual amounts of elementary guidance during practice. A common occurrence is for an instructor to interrupt practice for an entire class to explain basic points that are being missed. It may be, of course, that trainees cannot understand the guidance until they struggle with a task for a while. Nevertheless, the training analyst should ask whether a more adequate overview would have made the interruption unnecessary.

Improving inadequate overviews involves applications of Principles 6, 7, and 8. Overviews should be specific in what the trainee is to look for,

and how he is to respond or otherwise make use of the information when the time comes. An overview making use of an outline of key cues and actions on a guide sheet, or written on a chalkboard while they are being explained, can be especially helpful. If trainees have trouble understanding what is being said, demonstrations of the tasks being described should be included when feasible.

16. Appropriate Preliminary Experiences Are Not Provided

"Preliminary experiences" refers to those provided at the beginning of a lecture or practice session that are needed to understand overviews and task requirements.

Symptoms of this problem are similar to those resulting from poor overviews because trainees may flounder or need additional elementary guidance during practice. However, this difficulty is indicated when a trainee can recall points from the overview that are unquestionably specific, but cannot use the information. (The earlier discussion regarding entry skills identified additional indications of this problem.) Its correction calls for identifying specifically what trainees fail to understand, either through questioning or observations as discussed earlier, and arranging through demonstrations or special practice for the meanings to be acquired.

17. No Demonstration or Poor Demonstration Is Given

The concern is that trainees have unnecessary difficulties when they are not shown how a skill is supposed to be performed.

It is easy to tell whether a demonstration is given. It is not quite so easy to determine whether the demonstration could be seen and understood by all trainees, whether it was adequate, or even needed. However, by following the diagnostic scheme outlined for deficiency 1, the inadequacies of demonstrations can be identified, as well as the need for them.

Demonstrations are needed when trainees flounder at the outset or make an undue number of errors. If these things happen following a demonstration, then the demonstration was not adequate. The nature of the inadequacies then is the concern. It could be that too much was demonstrated at one time, and the trainees either could not remember it all or confused various task elements with each other. The presentation of the demonstration may have been too rapid, incomplete, difficult to watch because too many trainees were around, or given in such a perfunctory manner that the trainees paid less than full attention to it.

Earlier discussions of skill complexity, skill uniqueness, step sizes, and trainees' entry skills identify what to look for insofar as the amount of information covered in a demonstration is the problem. As for preparation of trainees to learn from the demonstration, the preceding sections on overviews and prerequisite experiences are pertinent.

Problems related to the manner of presentation and the content of the demonstration can be identified most easily by questioning the trainees and noting which skill elements seem to be unnecessarily troublesome. Therefore, an attempt should be made to interview trainees if problems related to demonstrations are suspected.<sup>1</sup> Specifically, determine what the trainees missed, and why. Was a missed skill element included in the demonstration? If so, did the trainees understand it at the time it was demonstrated? If they understood it at the time, forgetting is the problem and smaller steps are needed. If they did not understand it, was it because it was covered too rapidly? Were some skill elements left out or

---

<sup>1</sup>Care should be taken to assure that a proper sample of trainees are interviewed. For example, trainees in some viewing positions and distances may be able to observe a demonstration while trainees at other locations and distances may not. This is often a problem in large classes.

glossed over? Could all trainees see the demonstration well enough to follow it? Did they have opportunities to ask questions for clarification?

Straightforward applications of Principles 6, 7, and 8, as indicated by answers to the questions, would handle problems related to the manner of presentation and content of demonstrations. If classes are too large to see a demonstration as a single group, the demonstrations should be given to small subgroups and repeated until all trainees have been served. (If multiple demonstrations are necessary, they would have the advantage of permitting trainees having unusual difficulties to view the demonstration more than once.)

18. Trainees Do Not Have a Model of Performance to Follow

A key clue to the need for a demonstration of correct performance is the inability of trainees to tell by themselves when they are doing a job correctly. If they think an incorrect action is correct, or if they tend to be quite variable in performance, they need a model to go by. This problem can become apparent during any stage of training. In early stages, trainees may not know what to do at all. Later, they may show evidence of substantial learning, even to the point of occasional near-perfect performance. A giveaway, however, would be inconsistent performance. They would not understand task requirements clearly enough to perform the task correctly every time. They would perhaps miss finer points of cues and natural feedback, and their actions would lack the precision and discipline required.

The preceding discussion of demonstrations covers this problem in early stages of training. During later stages, model demonstrations are often needed to accomplish that final "step" of honing and refining skills (see discussion of Principle 9). Trainees must learn the difference between a correct, precise response, together with its cues and timing, and an

action that is almost, but not quite, correct. Highly precise feedback can help make these distinctions, but illustrations of the differences using ideal models of skill performance can help trainees see what changes in their performance are required.

19. There Are No Criteria for Performance or the Criteria Are Poor

If it is not clear how a skill should be performed, low levels and diverse patterns of performance are likely. HPGI stated the problem succinctly: "How can we expect a trainee to perform if he cannot detect the difference between correct and incorrect performance?" There is no basis for consistent guidance because there is no way to determine precisely what the trainee should do, or how. Nor can feedback help trainees distinguish between correct and incorrect actions if the difference between them is not clear to the instructor.

Through repetition the preceding paragraph belabors the issue. Yet, this deficiency should be emphasized because it is so common in training programs. More often than not, training objectives do not include a statement of the behavioral requirements that must be fulfilled for the objectives to be met. And commonly, the objectives themselves are stated so generally that they cannot guide training except in a vague way (e.g., "The trainee will engage a target according to acceptable standards"). The result is that instructors develop intuitive standards of their own. Performance criteria thus vary from one instructor to another; and because the criteria are rarely spelled out in such cases, a given instructor will likely be inconsistent himself in the performance standards he sets.

The place to start in identifying this deficiency is with formal statements of training objectives. Do they specify what trainees are to be able to do after training, the conditions and cues that determine when they are to do it, and the standards they must meet? If not, each instructor

must make his own decisions--in which case, do the instructors themselves spell out objectives in this manner? Are instructors consistent with each other, and with themselves, when they do develop criteria?

The training analyst should not be satisfied just because he discovers well defined, formal training objectives and performance criteria. There is still the question of whether instructors pay adequate attention to them. It would generally be necessary to observe instructors' behavior during training to clarify this issue. In some cases, questioning trainees regarding performance criteria may provide the needed information; but if poorly prepared trainees are interviewed, they may not know specifically why they are poorly prepared. An instructor could be employing criteria correctly when the trainees could not tell whether he is or not because they do not know the difference between quality and so-so performance.

The correction of this problem is primarily an administrative matter. The two aspects discussed here, poor training criteria and instructors' failure to use criteria, are discussed further in Section IV.

#### 20. The Trainee/Instructor Ratio Is Too Large

Training suffers when an instructor has more students than he can work with effectively. This problem is indicated any time individual trainees' difficulties cannot be corrected because instructors do not have the time or occasion to provide the individual attention needed for the correction. Stress has been placed on specific and timely uses of guidance and feedback. If an instructor does not have time to identify individual trainees' problems, and provide corrective instruction, he has too many trainees.

Of course, this is not an either-or issue. In a lecture-demonstration situation, the only requirements are that all trainees be able to hear



clearly, see all demonstrations adequately, and have opportunities to ask questions for clarification. During hands-on practice, on the other hand, considerable individual attention is often needed for effective, efficient training. This means that more instructors would have to be available when classes are large. However, beneficial trade-offs involving reduced class sizes are also possible. Specifically, students can be trained in less time when individualized guidance and feedback are possible. Proficiency advancement also becomes more feasible, which can save training time. (See earlier discussion under trainee/equipment ratio.) Fewer trainees may be involved at a given time, but what is lost by reducing instructor student loads may well be regained through classes of shorter duration, and with the probable extra benefits of more effective training and longer retention.

The correction of this training problem must begin with an administrative decision to determine the maximum number of students an instructor can handle effectively, and to reduce the student flow or increase the number of instructors accordingly. It would then be necessary to train instructors to provide the monitoring, specialized guidance, extra feedback, etc., that make for effective, efficient training. These topics are discussed in Section IV.

#### SUMMARY

This section discussed the diagnosis and correction of 20 instructional deficiencies. Schemes for diagnosing instructional deficiencies focused primarily on observations to make during practice sessions. Interpretations of observations and corrections of deficiencies were according to appropriate adaptations of the 15 principles regarding practice, guidance, and feedback presented in Section II.

#### IV. TRAINING DEFICIENCIES RELATED TO ADMINISTRATIVE PRACTICES

Section I pointed out that a number of problems that result in poor test performance after trainees complete training can be traced back to administrative practices and neglect. In most instances, the deficiencies and indications thereof that HPGI classified as "not skill related" fall into this group. There are also several deficiencies covered in Section III that are primarily administrative matters. However, the earlier treatments were concerned with reducing negative effects on training through adjustments in teaching methods, not removing the sources of problems. This section addresses the sources of these deficiencies that lie outside the realm of instructional practices as such. That is, all problems examined here require administrative resolve and action for their solution.

Whether or not the correction of these problems are a concern for the training analyst, an understanding of their nature and what is involved in their correction should provide a useful perspective for him. Also, some discussions in this section should help in understanding instructional deficiencies.

The discussions are organized under five heads: Indications of Need to Redesign Training Programs; Training Support and Facilitation; Instructor Characteristics and Qualifications; Management of Attitudes; and Problems in Performance Testing.

##### INDICATIONS OF NEED TO REDESIGN TRAINING PROGRAMS

Section III discussed ways to revise and adapt instructional practices to overcome a number of deficiencies in trainee performance. While the training adjustments are applicable to individual trainees with problems,

the emphasis was on problems shared by trainees in general. Thus, Section III addressed specific training program revisions in considerable detail.

Nevertheless, there can be general inadequacies in program design that call for more than specific revisions. Rethinking the general design of a program may well be required. Fifteen indications listed by HPGI of a need to make substantial revisions in a training program are listed below. They vary in the scope of implied redesign efforts required to avoid training deficiencies, but all imply a need for a systematic effort that will need administrative action and support.

1. Pertinent tasks are omitted from training.
2. There are no performance criteria, or criteria are poor.
3. Job aids should be, but are not, included in training.
4. Trainees are tested on content different from that in the program.
5. Test performance criteria are higher than training criteria.
6. Session times are inadequate for material to be covered.
7. Trainees in the program are different from those for whom the program was designed.
8. Trainees' entry skill levels are lower than those for whom the program was designed.
9. There is widespread failure on the first test attempt.
10. Trainees performed well on other tests covering other skills.
11. There is a history of poor performance by trainees completing the program.
12. Previous Training Effectiveness Analyses (now termed Training Program Evaluations) indicated poor training.
13. Most persons familiar with the training program rate it as poor or only fair.

14. An observer has difficulty describing the training plan.

15. An observer has difficulty correlating training tasks with the test.

The first six items identify shortcomings in training objectives and program implementation. The seventh and eighth reveal that assumptions regarding trainee characteristics, though perhaps valid at one time, no longer hold. Numbers 9-12 can indicate a general problem of ineffective training that may be due to a number of shortcomings.<sup>1</sup> The last two imply that there is little rhyme or reason to what goes on in training.

There are excellent, well documented procedural guides for developing training programs that help avoid all these problems.<sup>2</sup> While it may not be necessary to follow all aspects of any highly systematized approach, a general overview of the process will clarify what is involved and how it might be adapted.

At the outset, job/task analyses should identify what must be known and done to perform a skill correctly. The conditions and cues calling for the performance of a task and subtasks comprising it are specified, and the criteria that performance is to meet are defined. The job/task analyses also give an overall picture of what is involved in an operational job as well as details of the specific tasks that must be performed. Hence, tasks can be prioritized for training and a content can be clearly defined for a training program. Entry skills of trainees should be assessed to avoid unnecessary instruction on skills they have already acquired. Training objectives can then be derived to target every skill and skill element

---

<sup>1</sup>The trouble could be minor, however, insofar as No. 9 is concerned. See discussion in Section III of need to practice using skills before being tested on their use.

<sup>2</sup>See, for example, Interservice Procedures for Instructional Systems Development (TRADOC Pamphlet 350-30), August 1975; also Montemerlo and Tennyson, op. cit.

required for the tasks to be trained. Performance criteria would not be problems because they would be defined during the task analyses.

A course syllabus would then be defined, and training materials and resources required to implement the syllabus would be identified. When first implemented, it would be recognized that some changes would probably be needed, so procedures for a diagnostic evaluation of the program would be specified.

A program developed through a systematic process, and implemented accordingly, would not have the general shortcomings indicated by the 15 items listed above. If tasks or job aids are omitted from training, for example, the omission would be deliberate and with full understanding of what would have to be learned in subsequent training or on the job. Thus, a content is defined both for training and for performance testing. The training program would be geared to trainee characteristics, including the amount of time scheduled for training each skill. Criteria for performance appropriate during training and for testing would be clear. Trainees who succeed during training could be expected to succeed on the performance tests because the tests would key on known training content and performance criteria. And no careful observer would have difficulty recognizing a coherent training plan.

Depending on the thoroughness of the effort that designed the program originally, it may be necessary when difficulties arise to focus only on selected aspects of the program. If trainees' entry skills are much lower than anticipated, for example, early remedial instruction and special attention to early stages of training (see Section III) may be all that are needed. However, if a training program has been in operation for some time, it is quite possible that the skills being taught and the training

equipment used have become obsolete in some respects. (A formerly effective program for which items 3, 4, 5, 9, 10, 11, and 12 become applicable would suggest such an obsolescence.) A more inclusive analysis and more extensive program changes might thus be needed.

#### TRAINING SUPPORT AND FACILITATION

A number of factors related to inadequate administrative support and lack of facilitative policies can affect the quality of training. Some factors such as poor training equipment can have direct negative impacts on training. The effects of others such as failure to monitor quality of training may be subtle in that quality of training may deteriorate too gradually to be noticed. Twelve such factors are listed below that illustrate the range of administrative responsibility to support and facilitate training. Each factor is a fairly common problem in military training.

1. Trainee/instructor ratio too large.
2. Trainee/equipment ratio too large.
3. Poor, obsolete, or inaccurate training equipment.
4. Absence of task documentation.
5. Distractive/poor training environment.
6. Inadequate maintenance of training equipment.
7. Insufficient numbers or quality of training aids.
8. Insufficient numbers or quality of job aids.
9. Inadequate space for training.
10. Failure to monitor quality of training to assure effectiveness.
11. Poor communication among personnel at various levels of responsibility, and within single levels.
12. Failure to emphasize the importance of training through visible administrative interest and commitment.

A direct solution to these problems is always desirable but not always practical. The first problem could be eliminated, for example, if the number of instructors could be increased. A decrease in trainee flow would also alleviate this problem as well as the second one. Purchasing additional equipment would also relieve the second problem.

But it is not always possible to attack problems so directly, especially when additional funds are required or changes in numbers of personnel are entailed. Nevertheless, the point to bear in mind is that something can be done about every one of these problems. All that is required is administrative resolve to seek a practical improvement. It behooves the analyst who discovers these problems to call them to the attention of appropriate management personnel so that efforts toward solution can be undertaken.

Ways to alleviate the first three difficulties were discussed in Section III. While the adjustments explained there were viewed as stopgap measures, thorough systematic analyses of the alternatives presented may well reveal improvements that are satisfactory in the long run. If not, direct action as mentioned above would be necessary. As for Item 3, inadequate training equipment, unless the inadequacies are minor, more radical adjustments are called for. If poor equipment results in unusable training, or worse, training that leads to erroneous skill performance, it would be better to eliminate the equipment entirely than to try to force an adaptation as described earlier. In this case, a new way to teach the tasks involved would have to be found, or the tasks deleted from the program.

The same holds for training and job aids of low quality (items 7 and 8) unless they can be safely adapted as described in Section III. If these

aids are not sufficient in number, the discussion in that section regarding large trainee/equipment ratios is pertinent.

The issue of a facilitating environment and adequate training facilities (items 5 and 9) reduces ultimately to a question of priority: How important is training compared with other responsibilities of the training organization? If it is important, provide the space and physical environment needed. The principle barrier to providing adequate space and facilities is a belief that training can be accomplished under almost any conditions. Rarely is this assumption justified. Not only does training efficiency suffer when facilities are inadequate, but bad morale is likely. As explained later, negative attitudes resulting from bad morale can undermine any training program.

Items 4, 6, and 10-12 can also be handled readily, given a resolve to do so. And as is so often the case, it is better to prevent these difficulties than to deal with their effects. Prevention can be accomplished most easily by creating a mechanism for doing so, and designating someone to see that it functions properly. Task documentation can be made available; the maintenance status of training equipment can be monitored, and information regarding maintenance can be communicated to a designated person who is responsible for timely corrective actions. Monitoring training quality (item 10) calls for instituting a formal quality control program for identifying training deficiencies, for providing mechanisms for their correction, and for ensuring administrative cognizance of training practices and effectiveness.

Actions such as these would be visible indications of administrative interest in and commitment to training. They would not only provide the support needed, but they would go far toward ensuring positive attitudes of trainees and training personnel that are critical to quality training.



## INSTRUCTOR CHARACTERISTICS AND QUALIFICATIONS

Three common problems related to instructor characteristics and qualifications are:

1. Instructors may have undesirable attitudes toward training and their roles in a program.
2. They may not have the skill proficiency required for the program as designed.
3. They may not be adequately trained to teach.

The first two problems are largely matters of instructor selection or of the availability of appropriately qualified personnel from whom instructors may be selected. However, undesirable attitudes may develop after instructional duties begin (see later discussion of Management of Attitudes). The third problem can be resolved by providing the necessary training.

Caro, Shelnutt, and Spears<sup>1</sup> examined problems of selecting, training, and managing instructors for aircrew training programs. Their findings and recommendations hold for any instructors, however. The guides that follow are adapted from their report.

The selection of instructors should be based on their desire and ability to do the job. Ideally, they should have sought the assignment. They should have demonstrated above average performance in past assignments, and they should be mature, stable individuals who can work well with other people.

Instructors should be fully qualified in the skills they are to teach. Their effectiveness would generally be enhanced if they had also had operational experience with the tasks to be taught, for they could then provide a realistic atmosphere during training that can help trainees understand the importance of what they are learning.

---

<sup>1</sup>Caro, P.W., Shelnutt, J.B., and Spears, W.D. Utilization of Aircrew Training Devices (Tech. Rep. TR 80-01). Pensacola, FL: Seville Research Corporation, February 1980.

Before they begin teaching, instructors should go through comprehensive, formally structured training to prepare them to teach. Following training, the instructor should be able to demonstrate a practical knowledge of instructional technology such as that implied in Sections II and III. Also, his training should remove any deficiencies in his own performance of the skills to be taught, and update his skills if task requirements have changed since he last performed the tasks.

The instructor trainee should practice teaching the skills of concern, with supervision and critiques by a qualified instructor. While doing so, common student problems should be reviewed and the adaption of training techniques discussed with the supervisor.

During his tenure as an instructor, the instructor should receive continuation training as needed to refresh, refine, update, and expand his instructional capabilities. Scheduled periodic refresher training will guard against tendencies to become slipshod in teaching, and to depart from standard instructional procedures and criteria for evaluating student performance. Changes in skill performance requirements and newly validated teaching techniques, of course, should be reviewed when they appear.

Instructional duties of instructors should be given priority. Additional non-instructional responsibilities should not interfere with the time and effort required to teach, nor make instruction unduly burdensome. Moreover, evaluation of instructional proficiency should be weighted heavily in overall instructor proficiency reports.

#### MANAGEMENT OF ATTITUDES

HPGI listed four conditions and types of observations that indicate a problem with attitudes toward training:

1. Negative consequences for good test performance (e.g., peer disapproval, undesirable post-training assignments).
2. Absence of consequences for good test performance--it does not matter how a trainee performs.
3. Trainee absenteeism, tardiness, careless work, negative comments, etc.
4. Instructor absenteeism, tardiness, careless work, negative comments, etc.

Poor attitudes result in poor training. For example, peer pressure that prevents a trainee from performing well on a test will also prevent him from learning the skills in the first place. The same can be said for undesirable post-training assignments. Or, if it does not matter how one performs on a test, then it does not really matter what one learns (see discussions of uses of feedback in Section II).

There should be no question that unfavorable attitudes result in less skill development than would be the case if favorable attitudes prevailed. For this reason, negative attitudes among students and instructors should be a major administrative concern.

Successful management of attitudes requires a basic understanding of how they are formed and maintained. Attitudes are learned, but unlike skill learning, a favorable or unfavorable attitude toward training or a job can be learned thoroughly by simply being exposed to a group that holds the attitude. This learning process, usually termed "modeling," is the most profound basis for social behavior. Trainees model their peers and instructors. That is, they adopt the beliefs and value systems of those around them. To do otherwise would lead to ridicule and ostracism. Therefore, any attempt to foster favorable attitudes, and to prevent unfavorable attitudes, must focus on the local training community as a whole.

This means that the training environment is the primary consideration. A professional environment was stressed in Section II. It is now time to examine factors that promote professionalism in trainees and instructors.

First, the goals of training must be valued by the trainees and instructors. The goals will not be valued unless administrative personnel themselves value them. Furthermore, administrators must demonstrate that the training is important. It gets nowhere--in fact, it is usually counterproductive--to pay only lip service. Visible support for training and administrative actions with tangible results are required. No matter what he is told, a trainee will not believe that his efforts are worthwhile if he must train with inadequate equipment, if his instructors are careless or unqualified for their roles, or if his nontraining duties make concentrated learning efforts burdensome. Instructors will not value their roles if adequate training resources are not available, if nonteaching duties prevent them from giving instructional responsibilities the full attention they deserve, or if quality instruction is of little or no consequence for fitness reports. In brief, if there is no evidence that anyone else cares about quality training, why should a trainee or an instructor care?

Earlier discussions in this section on Training Support and Facilitation, and Instructor Characteristics and Qualifications, covered a number of points bearing on this issue, and they need not be repeated here. Those sections primarily addressed effective instruction, but by referring to them the reader can appreciate the scope of deliberate efforts required to demonstrate that quality training is valued.

A second consideration for fostering favorable attitudes is the prevention of undesirable attitudes in the first place. Once formed, negative

attitudes are difficult to change. Ideally, trainees or instructors should never be shanghaied to get them into a program for they will surely begin with feelings of resentment. In practice, coercion, at least of a limited sort, is often necessary. But negative effects on attitudes can be reduced if trainees and instructors are selected according to their likelihood of succeeding in their roles. Formal selection programs may require considerable effort, but the payoff could make it worth it.

A third consideration is to ensure success for trainees and instructors. As emphasized in Sections II and III, the tasks to be trained and the pacing of the training should be such that trainees make steady progress. If trainees succeed, their instructors do too.

Fourth, trainee and instructor success should be rewarded. If quality performance is not recognized, there is no need to strive for it. Proficiency advancement as discussed in Section III provides many opportunities to reward trainee success. Upon completing a stage of training, a trainee might be given a choice of interesting optional tasks to practice, or even free time, while others catch up with him. Or, he may progress directly to the next training task, with the privileges provided at the end of training. (It is hard for peer pressure to interfere with progress when a desired reward is received for reaching proficiency. In fact, negative peer pressures would probably not even develop.)

There are many ways to reward both trainees and instructors for successful performance. In many situations, simple published recognition by the training organization is adequate. But if no tangible rewards are offered, there is always the danger that official recognition will be viewed as a "gold star" for reading the Sunday school lesson.

Fifth, boredom should be avoided to the extent practical. Section III discussed ways to prevent or alleviate this problem during practice.

Similar points can be made concerning all activities, official or personal. The rule to keep in mind is, if a trainee (or instructor) is idle for long periods, let it be at his own choice and on his own time. That is, he can do what he wishes, including nothing, when he is not on duty; but when he is on duty he must work at his job. The pace of work should be reasonable, of course, and with rest periods. The thing to avoid is opportunities to let socializing, daydreaming, and other unrelated pursuits distract attention from training. A coffee break should be a clear break in the routine, not combined with a serious training activity.

Finally, there should be identifiable advocates of the training program and the job for which trainees are being prepared. One or more respected persons should demonstrate through their own enthusiasm that the training program and its goals are important. Enthusiastic instructors fill this role naturally. But a formally designated spokesman can increase the instructors' impact. Bulletin boards are used effectively by most training organizations to promote programs and goals. Personal contacts with a respected advocate could be even more effective.

#### PROBLEMS IN PERFORMANCE TESTING

HPGI placed heavy emphasis on problems related to performance testing. If a test is to provide information about effectiveness of training, it should be such that the results of effective training are not obscured by peculiarities of the test. In this light, the validity of the performance test is a critical administrative concern.

HPGI listed 16 problems related to performance tests:

1. Mismatch between training and test conditions.
2. Performance criteria unreasonably high.
3. Test criteria very much higher than training criteria.

4. Trainees not tested on same content taught during training.
5. Equipment used in test different from that used in training.
6. Job aids used during training but not on test.
7. Pass/fail criteria not clear.
8. Negative consequences for quality performance.
9. No consequences for quality performance.
10. Poor trainee attitude during test.
11. Boredom due to tedium of test tasks.
12. Poor test administration.
13. Use of inconsistent standards for scoring performance.
14. Poor directions provided during testing.
15. Excessive pressure during testing.
16. Performance on test (i.e., test results) "contaminated" by unauthorized intervention of test personnel.

The first 11 have been discussed previously. Parts of these discussions will be reviewed briefly to emphasize a few points.

The need for a systematic procedure for designing training programs was discussed at the beginning of this section. Such a procedure, extended to the final test, would take care of problems identified in the first seven items. However, the person who uses these seven items as guides for determining the appropriateness of a test must be forewarned that circumstances may not be as they appear. For example, it is common--and desirable when feasible--for a final test to sample operational conditions and performance requirements whether or not they characterized training. Efficient training usually requires special, contrived conditions. Therefore, a systematic approach to designing a training program may well dictate that there be differences in training and testing conditions. The

purpose of the test is to determine the extent to which skills learned in a contrived training situation are usable in operational settings which may change from day to day. This issue was discussed in Section III as a problem of realism. It was also explained that a "dry run" under test conditions should precede actual testing.

Except for item 2--"unreasonably high" criteria are by definition unreasonable--all of the first six items require interpretation. Test criteria may be higher because they could not be used as such during training. For example, imperfectly simulated conditions or equipment may be used during training that make operational criteria inapplicable. In such situations, the question for the analyst to ponder is not whether trainees achieve the test criteria levels, but do they approach them as closely as can reasonably be expected? A similar point holds for differences in equipment. A trainee may use a simulator during training, but he is not expected to go to battle with it. Was what he learned using a simulator (or any other training equipment) applicable to performance with actual equipment?

Test content (item 4) probably should vary unless trainees are not expected to do anything under any conditions except as practiced during training. This is hardly likely for a tank driver or a gunner. Tactical terrains and maneuvering requirements, and conditions for acquiring targets and estimating ranges, are highly variable. Trainees must learn to perform regardless of such variations. Again, the question is, does the test represent the same domain--the same general kind--of content that was covered in the training objectives?

Regarding item 6, a training analyst should distinguish between job aids and training aids. If the training plan is to teach the use of job



aids every time a task is performed, the job aids should be available on the test. If trainees are expected to perform without them, their training should target this objective. The reader is referred to a discussion of this topic in Section III.

Items 8-10 involve attitudes, and these items were discussed earlier. Item 11 regarding boredom was discussed under Attitudes, and also in Section III as it affects skill acquisition. If boredom is avoided or accommodated during training as described, it will be no problem during testing.

The remaining five items, together with numbers 2 and 7, are clearly matters of inadequate testing. As stated, 2 and 7 can be resolved through a systematic design for the training program. Items 12-16 call for specific administrative attention.

Requirements for adequate testing all flow from one principle: Differences in test performance should reflect differences among individuals in the characteristics of interest. Such an interpretation is possible only to the extent the test is valid and its administration is standardized. Validity was the concern of the discussion immediately preceding and other discussions that were cited. The focus now will be on standardization of testing procedures.

In brief, standardization means that every trainee is tested under comparable conditions and requirements. The directions they receive are accurate, complete, and understood in the same way by all trainees. For any given test, the same tasks are always presented in the same way and in the same sequence, and standardized time limits are used. Any intervention by testing personnel, whether helpful or otherwise, follows a consistent pattern. Its nature is specified beforehand, along with the circumstances under which interventions are to occur.

The problem of inconsistent scoring of performance (item 13) is very common. It is also very serious. Not only do different scorers often disagree with each other, a given scorer can be inconsistent with himself. The only way to avoid the problem is to have clear-cut scoring criteria (preferably objective indicators), and train personnel to use them in the same way. If two scorers working independently score the same performance and get different results, either the standards are unclear or the scorers have not been adequately trained.

A frequent cause of scoring inconsistencies is a dependence on an overall rating of performance. A trainee may do, say, ten things, six of them correctly, two incorrectly, and two of questionable adequacy. How much can an observer remember about these details when he assigns an overall rating? Is he likely to remember performance on every step and always weight each step the same amount? Just raising these questions reveals that a more systematic procedure is needed. It would be better to use a checklist and identify each correct and incorrect action, each cue noticed and missed, etc. With a record of the actual performance, evaluations could be made later according to a standardized scheme.

Item 15 refers to "excessive" pressures that prevent a trainee from demonstrating what he can do. Undue pressures can be difficult to deal with, so some explanation of what is involved is in order. First, conscientious trainees will feel some pressure any time they take a formal test, and the amount of pressure will relate to their confidence in their ability to perform. If many trainees exhibit an unusual nervousness, however, it means that the test is unnecessarily threatening to them. (As a check on such an inference, one might determine if trainees had shown proficiency during training on the skills they do poorly on during the test.)

Anxiety regarding tests arises in many ways, most often from comments by instructors and good natured harassment by other trainees who have already "been through the mill." Tensions can be eased if instructional personnel exhibit a general confidence in graduates of the training program, pointing to success rates of previous graduates.

Pressures also arise when time limits for performance during tests are more strict than the trainees are accustomed to, or when new applications of skills will be necessary. These pressures can be reduced by imposing the same time limits, and requiring new applications, during later stages of training.

The task for a training analyst is to determine when pressures are "excessive" and when they are not. If a trainee cannot perform under reasonable pressures for whatever reason, his training has not been completely successful. If pressures appear unreasonable, however, then the test cannot reveal what it is supposed to. In this case, corrective actions are needed.

#### SUMMARY

This section discussed training deficiencies that arise because of administrative practices and neglect. Forty-five problems or indications of problems were addressed, some more than once. They were grouped under five heads: Indications of Need to Redesign Training Programs; Training Support and Facilitation; Instructor Characteristics and Qualifications; Management of Attitudes; and Problems in Performance Testing. The focus for each discussion was the need for administrative resolve and action to prevent problems from arising when possible, and to take prompt corrective steps when they do occur.